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INDUCTION OF EXPANDED STATES OF CONSCIOUSNESS USING SPATIAL ANGLE MODULATION™ AUDIO SUPPORT TECHNOLOGY

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After retiring from the military, Skip served in the roles of research director, executive director and president of The Monroe Institute over the last twenty-five years. As research director he published technical research on methods for expanding consciousness. Now, working closely with his co-inventor, Mike Turner, he is further developing the Spatial Angle Modulation™ (SAM) audio technology and is the principle designer of SAM-based educational materials and programs.

Background

In 2008 The Monroe Institute began to investigate a complementary method of producing the consciousness-altering effects of Hemi-Sync®, a safe and effective essential component of our educational programs for decades. We were looking for an audio support technology that would extend the range, scope, and flexibility of our seminar programs and educational materials. The new Spatial Angle Modulation™ (SAM) technology was developed to meet those requirements. SAM will not replace existing Hemi-Sync® products or programs, but will hopefully provide the platform for future seminar programs and educational materials.

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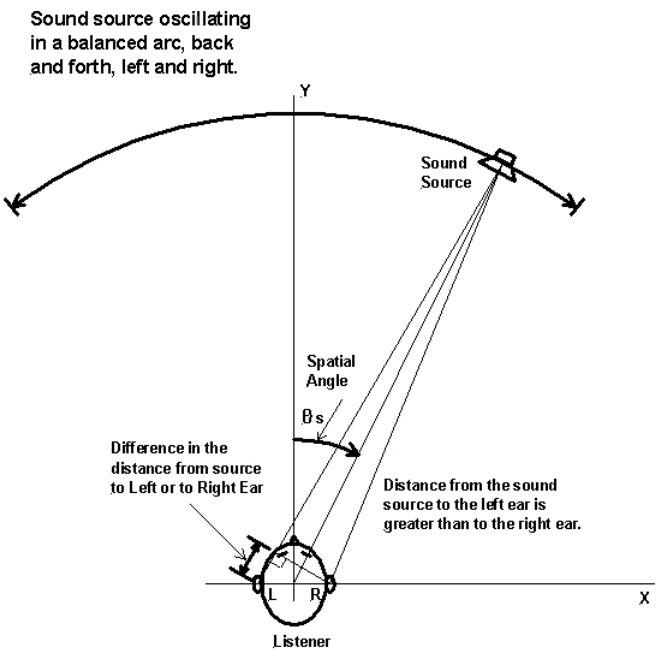
Rather than Hemi-Sync's binaural beating to achieve its effect, SAM uses a single frequency tone digitally movement-modulated for presentation in a stereophonic field. Using stereo headphones or speakers, the spatial angle of the apparent sound source moves more rapidly than the brain can process as a Doppler shift anomaly. As a result, the brain produces a modulation or change in the tone—a tremolo effect similar to binaural beating. It is this tremolo effect coupled with the size and orientation of the movement arc produced that give SAM its ability to influence regional brain activity and changes in states of consciousness.



The Induction of States of Consciousness

When a person's ordinary baseline state of consciousness is active and stable, it is said to be immersed in a pattern of supportive psychological functions in spite of environmental changes (Tart, 1975). Stated another way, an individual's everyday baseline state of consciousness tends to continue functioning as the individual moves through his or her day.

Inducing the transition to an altered state of consciousness is seen as requiring disrupting and patterning stimuli to begin the induction (stage 1). When the disrupting stimuli are successful in breaking down the organization of the baseline state, a transitional period occurs and the disrupting stimuli are not as important and can be subjugated by the now more important patterning stimuli (stage 2). The patterning stimuli must then encourage the now isolated psychological structures from the baseline into a new construction, so that an innovative, self-stabilized altered state of consciousness forms (stage 3) (Tart, 1975). Within the context of the SAM audio support technology, this is referred to as the three-stage process of disruption-induction-stabilization.

During the "disruption" stage, certain specific SAM movement-arc oscillations act to disrupt the listener's baseline state of consciousness, while others provide stimuli encouraging the listener in the direction of the desired altered state of consciousness. During the formal "induction" stage, disruptive stimuli fall away and state-specific SAM movement-arc patterns become dominant. Once the desired altered state of consciousness is fully achieved, the "stabilization" stage begins and SAM arcs are adjusted to simply support the preferred state.

Once the altered state of consciousness is stabilized, it effectively becomes a new baseline. To return to the original baseline state, the three-stage process begins again, this time targeting a return to what is usually the normal waking state. Many times, simply quieting the SAM "stabilization" stimuli can be enough to bring the listener back to the normal waking-state baseline.

SAM can be used in conjunction with music; pleasing natural background sounds, e.g., surf, rain, wind, etc.; artificially produced background sounds, e.g., pink sound, brown sound, etc.; and verbal guidance in the form of narrative inserts strategically placed to enhance the three-step induction process. The use of these additional components traditionally enhances the effectiveness of audio induction procedures.

This process is particularly effective when combined with other sensory-information techniques (such as sitting in a darkened room), social-psychological conditioning tools (such as intra-group affirmation, affinity, and/or communion), and educational curriculum (in which new cognitive, "consciousness expansion" skills are learned, i.e., breath work, visualization, etc.) such as are provided within The Monroe Institute's many educational programs.

Binaural beats, monaural beats, and isochronic tones have been said to "entrain brainwaves," yet there has been no physiological mechanism proposed that would explain such entrainment. This notion of entrainment is a *post hoc ergo propter hoc,* Latin for "after this, therefore because of this," offer of proof. It is a logical fallacy implying that since changes in brainwaves followed the introduction sound (e.g., binaural beats), the changes in brainwaves must

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have been caused by the sound. This *post hoc ergo propter hoc* offer of proof is also sometimes referred to as false cause, coincidental correlation, or correlation not causation.

Post hoc is a particularly tempting error because the intrinsic temporal sequence appears to be integral to causality. The fallacy lies in coming to a conclusion based solely on the order of events, rather than taking into account other factors that might rule out the connection.

From a neuroscientific perspective, these audio stimuli are being neurologically routed to the reticular formation (Swann et al., 1982) and simultaneously volume conducted to the cortex, where they can be objectively measured as a series of EEG-evoked potentials (Oster, 1973; Smith, Marsh, & Brown, 1975; Marsh, Brown, & Smith, 1975; Smith et al., 1978; Hink et al., 1980), not brainwave arousal associated with states of consciousness.

The traditional neuroscientific community says that changes seen in global brainwave arousal (differentiated from an EEG-evoked potential response discussed above) are functions of the extended reticular-thalamic activation system (ERTAS), which regulates brainwave activity (Newman, 1997). The reticular activating system interprets and reacts to information from internal stimuli, feelings, attitudes, and beliefs as well as external sensory stimuli (i.e., audio input) by regulating arousal states, attentional focus, and levels of awareness (Empson, 1986; Tice & Steinberg, 1989).

This well-understood ERTAS mechanism may explain the objective measureable changes in brainwave arousal noted with binaural beats, monaural beats, and isochronic tones, where "entrainment" fails to do so. But the first-person experience of consciousness is much more than just arousal states, attentional focus, and levels of awareness. The cognitive content of the experience gives it meaning to the individual and provides clues to understanding the underlying mechanisms behind such perceptions.

Studying the qualitative aspects of altered-state experiences (the cognitive content) over the last three decades led The Monroe Institute to the understanding of further neurological mechanisms involved in those who have deep, meaningful experiences in extraordinary states of consciousness. Such experiences would appear to involve nonlocal (in the "quantum nonlocality" or "quantum coherence" sense) perceptions of reality and the universe. For such perceptions to emerge, consciousness must necessarily extend beyond the physical body. Presumably, the brain organ must be somehow quantum entangled with information beyond the simplex concept of arousal states, attentional focus, and levels of awareness.

If mind-consciousness is not confined to the brain organ within the body, why then does science relate states of consciousness and mental functioning to brainwaves? The question can be answered in terms of an instrumentation exemplar. There is no objective way to measure mind or consciousness with an instrument. Mind-consciousness appears to be a field phenomenon that interfaces with the body and the neurological structures of the brain (Hunt, 1995). This field cannot be measured directly with current instrumentation. On the other hand, the electrical potentials of the body can be measured and easily quantified. Contemporary science likes things that can be measured and quantified. The problem here lies in the oversimplification of the observations. EEG patterns measured on the cortex are the result of electroneurological activity of the brain. But the brain's electroneurological activity is not mind-consciousness.

Therefore, EEG measurements are only an indirect means of assessing the mind-consciousness interface with the neurological structures of the brain. As crude as this may seem, the EEG has been a reliable way for researchers to estimate states of consciousness based on the relative proportions of EEG frequencies. Stated another way, certain EEG patterns have been historically associated with specific states of consciousness. Although not an absolute, it is reasonable to assume, given the current EEG literature, that if a specific EEG pattern emerges it is probably accompanied by a particular state of consciousness. This is completely different from saying that a particular stimulus entrains, drives, or causes changes in EEG (a *post hoc ergo propter hoc* assertion).

The SAM audio support technology is distinct from other audio-guidance technologies in that it is designed to support experiences in altered states of consciousness specifically using new, leading-edge understandings in neuroscience to optimize its effectiveness. There is no supposition by The Monroe Institute that SAM entrains or drives brainwave arousal as in the binaural-beat model. We do, however, think that some objective evidence for SAM's effectiveness in facilitating enhanced states of awareness will be shown in ongoing studies of gamma synchrony as an electrophysiological correlate of conscious awareness.

SAM induces altered states of consciousness that most likely would be evidenced through both alterations in one's

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qualitative experience of reality (already noted in hundreds of experiences) and the objective measurement of changes in brainwave arousal due to the ERTAS mechanism's regulation of the neurotransmitter acetylcholine, which appears to be influential in the quantum coherence of parallel arrayed neuronal microtubules (Woolf & Hameroff, 2001).

One aspect of brain functioning somewhat beyond arousal states, attentional focus, and levels of awareness involves the cross-callosal connectivity of the hemispheric structure of the brain and the effect that interaction has on consciousness. SAM can actually enhance the effectiveness of the brain by enabling the user to either synchronize the arousal level of both hemispheres or calm down an overactive left or right hemisphere. The two cerebral hemispheres are like two separate information-processing modules. Both are complex cognitive systems; both process information independently and in parallel, and their interaction is neither arbitrary nor continuous (Zaidel, 1985).

Because of this, states of consciousness can be defined not only in terms of brainwave arousal states, attentional focus, and levels of awareness, but also in terms of hemispheric specialization and/or interaction. Some desired states of consciousness may require facile inter-hemispheric integration, while others may call for a unique hemispheric processing style (Zaidel, 1986). An individual's cognitive repertoire, and therefore his/her ability to perceive reality and deal with the everyday world, is subject to his/her ability to control these states of consciousness, including the mediation of inter-hemispheric processing.

Hemispheric dominance in particular has an ultradian periodicity (Rossi, 1986). Individuals can, however, learn to control hemispheric dominance through the disciplines of biofeedback, yogic breathing, and others (Budzynski, 1986). But SAM is the only method of precise control of hemispheric specialization and/or interaction and the associated brainwave arousal states, attentional focus, and levels of awareness. The result of such control is the maximizing of experiences in altered states of consciousness, or, put another way, the effective employment of appropriate states of consciousness to state-specific environments or situations.

SAM arcs can be generated to facilitate inter-hemispheric integration (synchrony) or to specifically suppress left/right hemispheric dominance. If a state of consciousness is desired that requires inter-hemispheric processing, then conventional symmetrical SAM arcs are used. A conventional SAM signal generates identical movement-arc stimuli in each hemisphere and will encourage the same arousal level in both hemispheres, establishing equivalent environments and maximizing inter-hemispheric neural communication.

If a state of consciousness is desired that requires quieting a dominant hemisphere, then unconventional, special SAM arcs are used. An unconventional SAM signal is one in which the SAM movement-arc in one hemisphere is out of phase and/or frequency with the SAM arc presented to the other hemisphere. This calming down of a dominant hemisphere is possible, fortunately, by virtue of the physiology of the brain. The acoustic nerve fibers of each ear are unequally divided between the hemispheres. From each ear more nerve fibers (more SAM arc stimulation) go to the opposing hemisphere than to the local hemisphere (Luria, 1970).

SAM uses multiple movement-arcs with different frequencies that may be virtually located in many different spatial regions using the arc location and size parameters as illustrated below. This enables stimuli to be focused singularly or on a variety of cortical regions simultaneously. An almost limitless number of subtly different tremolo effects operating at different rates can be created. This flexibility enables unprecedented accuracy in the induction of altered states of consciousness; a wider variety of accessible states; a more reliable and effective methodology; a faster response time for the listener; and deeper emersion during the stabilization phase of induction compared to other audio-guidance technologies.

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Another aspect of brain functioning that extends beyond basic concepts of arousal states, attentional focus, and levels of awareness, involves the brain's quantum entanglement with nonlocal information and perceptions of reality. Spatial Angle Modulation is designed to be a microtubule spanner. The methodology supposes, given the present scientific state-of-the-art, that consciousness requires quantum coherence in parallel arrayed neuronal microtubules, viz., Roger Penrose's "objective reduction" (Hameroff & Penrose, 1996) and uses the resonant tremolo stimulus and frequencies of the SAM oscillating movement-arcs to support and enhance alignment of these cellular structures (Yagi, Kamimura, Kaniya, 1994), viz., the Cymatic effect (Jenny, 2001).

This response to the various SAM stimuli necessarily alters the geometry of zero-point-field (ZPF) spaces (plenums) of tubulin structures at molecular and atomic levels. As the geometric symmetry of the plenums increase, so does ZPF quantum coherence—both within plenums and between geometrically matching plenums. Hypothetically, the greater the quantum coherence quotient, the more nonlocal awareness emerges. This may also explain why greater hemispheric coherence described above typifies extraordinary states of consciousness and profound personal experiences; there is simply a greater quantum coherence quotient when the left and right hemispheres are "in tune" with each other.

Binaural beats, monaural beats, and isochronic tones are by nature limited in their flexibility and overall potential, both in design and application. SAM was created with the intent of overcoming and transcending these limitations.

In regard to design, the only significant variables available with binaural beats, for example, are the volume and the frequencies of the two separate tones used to create the binaural-beat sound effect. As a result, its overall application is limited by its inability to independently provide both disruptive and patterning stimuli to different brain regions and separate hemispheres. Binaural beats are physiologically ineffective above about 20Hz (Oster, 1973), yet gamma frequencies in the range of 40Hz have recently been discovered to be critical to the quantum aspects of brain function, especially hemispheric coherence (Hameroff, 2010). SAM is not confined by these same limitations.

Comparing the signals used for binaural beats, monaural beats, and isochronic tones with those presented for SAM, it is clear that Spatial Angle Modulation offers a wealth of possibilities that are not available with these other methods. The most significant factors in the SAM signal format for creating a shift in consciousness are (1) the differences in signal delay that occur as a sound in a natural environment reaches the ears of a listener and (2) the way these delay differences change as the signal source moves in the environment. In addition to controlling the nominal frequency of the sound source and the frequency at which the arc tremolo effect is produced, there are several other parameters that can be adjusted to control spatial aspects of the signal and its neurological effects.

As well as controlling the SAM carrier frequency and tremolo frequencies, SAM also provides more degrees of freedom in controlling arc parameters. By controlling the peak phase deviation, an equivalent sound source can follow arcs of different sizes or even extend into situations that have no physical correlate. By controlling the pair of phase constants in the SAM format, movement arcs can be assigned to different apparent angular locations in longitude and latitude. Neglecting volume as a parameter, which is common to any sound format, the basic binaural-beat format, for example, offers only two important degrees of freedom in its choice of left and right frequencies; SAM offers five degrees of freedom with its choices of carrier frequency, modulation frequency, peak phase deviation, and the angular offset provided by a pair of constants and the combination of different angular presentations.

There are other naturally occurring means of entering into similar altered states, such as that of extreme relaxation, breathing techniques, and/or singing and chanting. The SAM audio support technology was designed and intended to be used in conjunction with these and other consciousness-shifting techniques (such as sitting in a darkened room), social-psychological conditioning tools (such as intra-group affirmation, affinity and/or communion), and educational curriculum (in which new cognitive, "consciousness expansion" skills are learned, i.e., breath work, visualization, etc.).

SAM is intended to be a safe and effective means of facilitating altered states in which the listener can engage in personal exploration and/or address a variety of physiological and/or psychological concerns. SAM has applications in a number of areas, including: inducement of sleep, lucid dreaming, heightened awareness during the normal waking state, focusing of attention, increasing mental and physical relaxation, enhancing intellectual performance in various mental disciplines, the enhancement of creativity, and the acquisition of "extraordinary" abilities such as nonlocal knowing, etc.

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In short, SAM is distinct from other audio-guidance technologies intended to facilitate shifts in consciousness in the listener in that (1) SAM works more quickly than other methods, (2) SAM technology utilizes a distinct signal format from other audio technologies, and (3) the SAM signal format is unique in its increased flexibility in breadth and arrangement of signals (specifically, its carrier frequency, modulation frequency, peak phase deviation, and the angular presentations). This allows for increased options for creating a greater number of signal "symphonies," thereby also allowing for a wider variety of psychological-subjective and neurological effects in the listener.

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